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A GEOGRAPHICAL SKETCH OF TITICACA, THE ISLAND OF THE SUN[1]

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INTRODUCTION.

Lake Titicaca belongs to that restricted group of scenic features which surpasses the expectations of experienced travelers. Its large size (100x38 miles), its profound depth (exceeding 900 feet), and its position on a mountain-bordered plateau 12,500 feet above sea level, give to the lake a unique place among inland water bodies. Titicaca (the Island of the Sun, in Inca traditions, and *Aymartharu,* in the language of the native tribes) rises abruptly from the level expanse of the lake water and is the largest of thirty-six islands and the one about which mythology and history center.

The setting of Titicaca Island is in every way picturesque. Far to the east, but plainly visible, the giant Sorata, draped in a mantle of snow with glacial fringes extending downward some thousands of feet, dominates the landscape—a mountain mass so colossal in size and elevation (21,520 feet, according to Conway) and so dazzling white in this rarified atmosphere that its outline is reflected in the waters of the lake. Trailing off to the northwest, but maintaining a commanding position, the cordillera passes beyond the range of vision. From high points on the island Illimani comes into view and shares with Sorata the mastery of the landscape. Like Sorata the bulk of Illimani is incredibly enormous, and its dominance of the landscape is so complete that the intervening distance of one hundred miles, marked by canyons, plateaus, and mountain groups, seems to have been eliminated. To the south and west the eye traverses ridges and steps of nearly bare rock leading to the summits of the Western Cordillera. Between the two ranges lies the Titicaca plateau—*altiplanicie* of the Spaniards—a region which exhibits considerable relief when the rugged Cordillera Real and the Maritime Cordilleras are eliminated from view.

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[1] A visit to Lake Titicaca, authorized by the Director of the Peruvian Expedition of 1912, was made possible through the courtesy of the Peruvian Corporation, represented by Mr. F. S. Blaisdell, Manager of the Ferro-carril del Sur, who furnished transportation to Mrs. Gregory and me for two traverses of the lake in the steamer *Coya.* At a later date the steamer *Yavari* was placed at our disposal, thus affording an opportunity for a study of the "Island of the Sun." I wish here to express my appreciation of the interest in scientific work shown by the officers of the Peruvian Corporation and to express my thanks to the ships' officers and to Señors Laro and Zuniga for information regarding the island and its inhabitants.

I desire also to acknowledge my obligation to Mr. A. F. Bandelier, whose admirable volume "The Islands of Titicaca and Koati" came into my hands after the return of the Expedition to the United States.

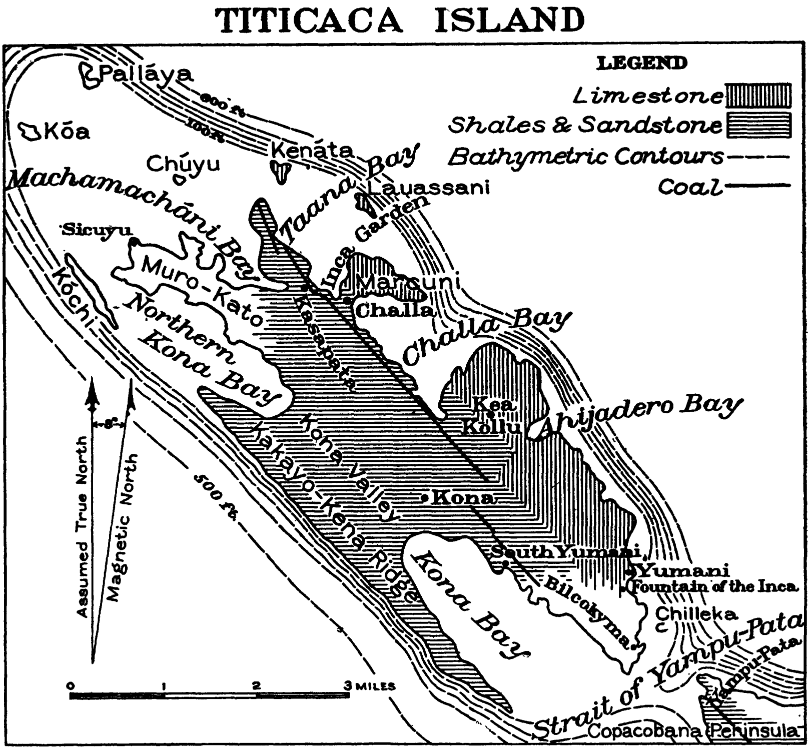
TITICACA ISLAND

FIG. 1—Map of Titicaca Island. Scale, 1:1,300,000. Outline based on map by Bandelier. Areas marked limestone include the most productive soil.
N. B. "Copacobana Peninsula" should read "Copacabana Peninsula."

During the time spent on and about Titicaca the sky was a constant source of delight, and, if November scenes are in any way typical, I can imagine no place where the painter of clouds and sunsets and atmospheric effects could find a more promising field. Rarely is the sky without cirrus and stratus clouds, while cumulus and nimbus forms mark the passage of storms. The brilliant sunsets which light up the west with bands of fiery red and purple give to the water a bronze glow peculiarly fascinating in its subtle changes. On three occasions the sunset colors were so strong and so brilliant that the crests of the Cordillera Real received a coating of gold interrupted by bands of violet marking the position of glaciers and névé fields. The captain of the steamer informed me that " alpenglow " is not infrequently seen.

The surface of Lake Titicaca is interrupted by numerous islands and by forests of reeds, which in places extend far out from shore and even close the passage into the smaller bays. The water of the lake itself reflects the deep blue color characteristic of mountain lakes, but its surface is streaked with curious bands of green—a phenomenon for which I have no explanation to offer. During our stay the lake was calm except for the small waves lapping the beach and the rippled surface and moderate surf caused by the wind of an afternoon storm. During the southern summer, however, the natives report that squalls and rough water are frequently encountered and that navigation in the canoe-like *balsas* becomes precarious. The shores of the lake and the islands are practically bare of vegetation and exhibit the brown tones so commonly met with in semi-arid regions. Here and there scattered vegetation adds variety to the landscape, but bare rock and flats of gravel are predominating features even along the stream courses. Approaching Titicaca Island, patches of green, marking the site of cultivated fields and of springs, become visible, and the outline of ancient terraces (*andenes*) are shown by lines of grass, shrubbery, and occasionally of trees.

As seen from Titicaca Island the grouping of snow-clad mountain peaks, barren foothills, desert, intermontane flats, in the midst of which is set a lake dotted with islands of rock and of reeds, constitutes one of the magnificent panoramas of the world. To me the entire setting of the Island of the Sun is interesting and beautiful, and to one who has felt the fascination of desert scenery "dismal monotony," " unprepossessing belt of bleak slopes, rocky humps, and scattered islets," "utter desolation" (phrases used by certain writers) seem strangely out of place.

An additional interest is given the scene by the thought that the waters of the lake were navigated and its shores and islands inhabited for centuries by a vanquished race whose story has never been told.

PHYSICAL ENVIRONMENT.

The fundamental influence in human affairs of topography, climate, soil, water-supply, fauna and flora, is well illustrated by the Indians of Titicaca, whose struggle for existence and advancement has been directly with nature, modified only in small degree by other influences. Segregated in small communities scattered along the shores and on the islands of Lake Titicaca, each group engaged in the absorbing task of securing a bare livelihood, there was little opportunity for mutual uplift and for learning or practicing those arts which lead to higher stages of civilization. Exhausting and continuous physical exertion combined with scant nutrition appear to be unsuitable soil for the cultivation of higher intellectual and ethical concepts. Contemporaneous groups at La Paz, Cochabamba, Cuzco, and Arequipa, which, because of more favorable environment, attained a higher status, were separated from the Titicaca tribes by an inhospitable zone across which their influence was but rarely extended. While there is evidence for the belief that climatic fluctuations have from time to time produced more favorable conditions than now surround these people, still their continuous subjection to nature is evident. Doubtless, for centuries, the Indians of Titicaca Island have been agriculturists and herdsmen, and the crude stage reached in both these occupations reflects their physical environment.

Topography.—The island of Titicaca is essentially a continuation northwestward of the peninsula of Copacabana, from which it is separated by the straits of Yampupata (Figs. 1 and 2). The island rests on a narrow underwater platform from which emerge also seven small islands, all less than two miles from the larger mass. Immediately bordering the submerged platform the water attains on the north and west sides a depth exceeding 600 feet, and even at the south, where Titicaca is separated from Copacabana Peninsula by about three-fourths of a mile, the depth of water in the straits is something more than 100 feet. The coast line of Titicaca Island is deeply indented. Besides the larger bays shown on the map there are fifteen or twenty smaller indentations, each with its narrow belt of beach, marking the mouths of ephemeral streams. The beaches are not extensive, and a traverse of the strand line involves the climbing of precipitous cliffs which, rising abruptly from deep water, form headlands of bare rock (Fig. 4). The low,

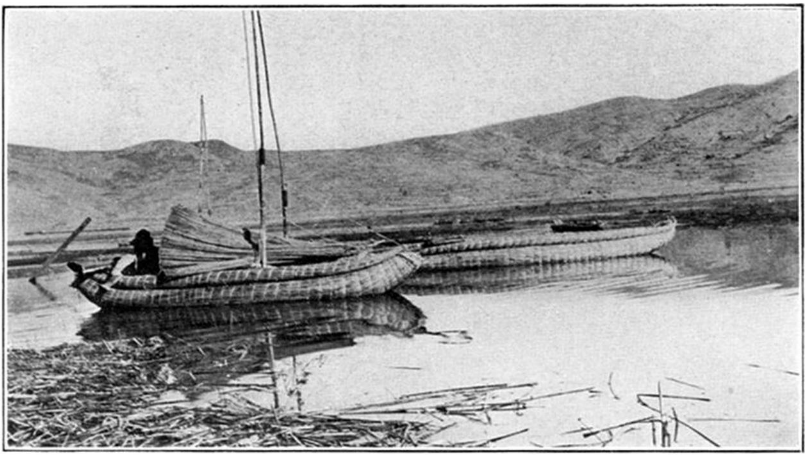

FIG. 2—General view of the Bolivian shore. Note the barren, maturely developed hills and the wide extent of delta flat. The "totora" *balsas* in the foreground are typical in shape and construction, but are larger than the average.

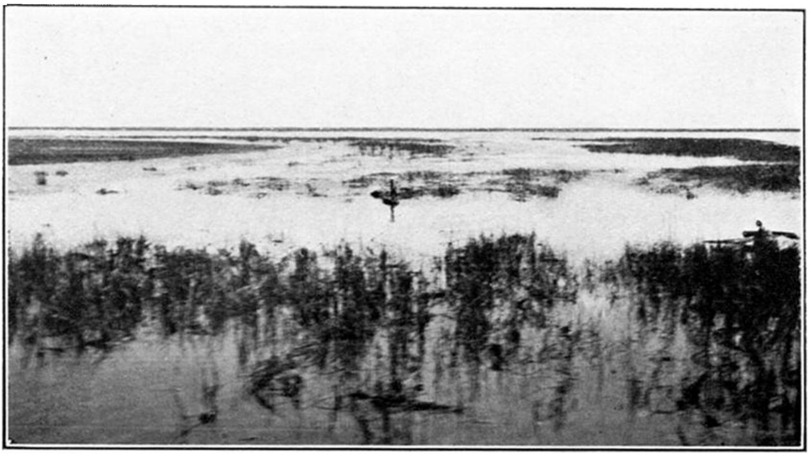

FIG. 3—Field of *totora*, four miles from shore. The Aymara Indians in their tiny craft are collecting these reeds for the construction of *balsas*.

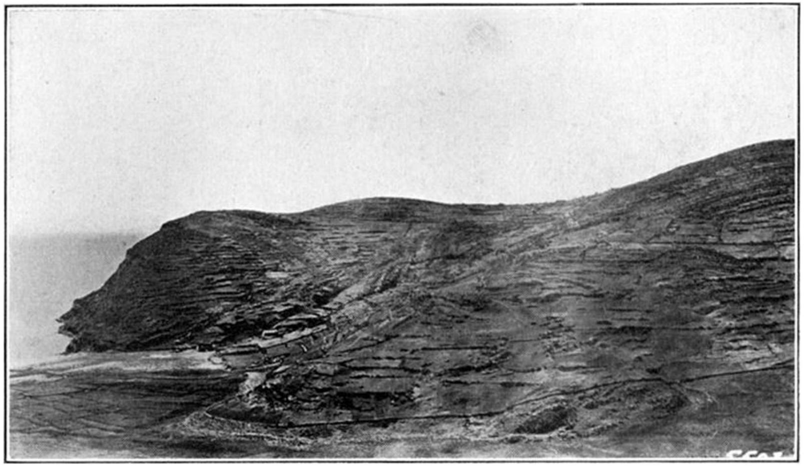

Fig. 4—The village of Kea, looking southwest. Note the terraced fields (*andenes*), the absence of vegetation, and the character of the coast line. K. C. Heald, photo.

narrow beaches of sand and wave-worn gravel slope gently lakeward for a short distance only to drop abruptly into the depths. No wharfs of more than a few feet in length are found on the coast, and so sudden is the drop from narrow beach to navigable water that the lake steamers may safely approach within one to two hundred feet of the shore, even in sheltered coves.

In ground plan the island is a ridge with a length of approximately seven miles; its width is in most places less than two miles, and only at one point was a width of three miles measured. United to the central ridge by a broad band is the secondary ridge of Kakáyo-Kéna—a remarkable hogback of resistant sandstone which faces the lake as a precipitous wall nearly five miles in length. On the opposite side of the backbone the promontory of Kea-Kollu attains an abnormal development owing to the character and attitude of its strata, and additional irregularity is given to the outline by the peninsula of Marcuni, which, in reality, is a rock island tied to the main land by a low, double-faced beach. With the exception of the cliffs which characterize the coast line and the steep faces of inclined strata, the surface of the island exhibits little sharp relief. Flattened domes and rounded ridges with northwest-southeast trend, separated by flat valleys and broad divides, give to the island its surface topography. A large part of the island maintains a height of 400 to 500 feet above the level of the lake, and at the most elevated points a barometer reading of over 800 feet (13,300 feet above sea)[2] was obtained.

Soil.—The soil of the island is distributed in patches which vary widely in physical character and in potential fertility. Something like one-fourth of the surface is bare ledge which supports vegetation only in crevices and along joint and bedding planes. Another large area is covered by a film of decomposed rock containing little of the finer material demanded by plants. Even in the better fields, boulders make up a considerable proportion of the soil constituents. With the exception of insignificant alluvium and beach deposits, the soil of the island has been developed *in situ* from the underlying rock, and, since bed rock is prevailing sandstone and siliceous shale, there is a general deficiency of inorganic plant foods. Along the belt passing through Challa and North Yumani the underlying limestone produces more favorable conditions, and here are located the more fertile fields, the larger villages and the only extensive hacienda on the island. Speaking broadly, the indefinite line separating tilled from grazing areas corresponds to the geologic boundaries of limestone and sandstone (see map, Fig. 1). Soil water on the slopes and higher lands is frequently deficient, owing to the seasonal distribution of rain and to the rapid run-off which allows inadequate soil absorption. On the other hand, swamps and seeps of an acre or less in extent occur along or near the coast.

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[2] I am unable to account for the error of Squier (Peru, p 335), who states that the crest of the island is 2,000 feet above the lake and that paths run along "dizzy eminences.

Water Supply.—Water for irrigation and domestic use is supplied by streams of steep gradient rarely exceeding one-half mile in length. With the exception of a few tiny rills fed by springs and seeps, the water channels are abandoned during the dry season (June to December). During the rainy season the larger stream courses are filled and emptied in response to the passage of storms. Numerous springs of limited and fluctuating flow, with water sufficient for the irrigation of garden plots, occur especially along the northeast coast, where the attitude of the rock and the composition of the soil cover are favorable. The water of the lake, especially if taken some distance from shore, is palatable and all of it is suitable for household purposes.

Climate.—The fundamental factors which determine the climate of Titicaca Island are latitude (15° 20′ to 16° 35′ S.), elevation above sea (12,500 feet), insular position in a lake of considerable size, and location on a wind-swept, mountain-bordered plateau. The temperature is characterized by uniformity. Bandelier records a mean temperature of 55° for summer and early autumn with variations from month to month of less than 1°. The maxima and minima were: January, 63.5°, 47°; February, 65°, 45°; March, 64°, 43°. The annual range of temperature, based on Bandelier's figures, is 32°. During July and August, the southern winter, Le Maire obtained four noon readings with a mean of 50.9°. These readings were obtained at four different stations, including Puno (57.3°)., which, because of its location, gives abnormally high values. My noon readings for the last three days of November were 52°, 55°, 54.3°, respectively. Agassiz observed noon temperatures of 54.3°, the mean of four successive days in February. The winter records for the island of Koati given by Bandelier for the period June 18th to July 1st are: maximum, 50°, minimum, 33°. Ice was noted at Huarina on August 18th and by Conway on August 26th—a phenomenon which the ships' officers say is not infrequent, though always confined to shores and shallow bays. While the observations thus far made lack the continuity and localization demanded for scientific discussion, they are, when taken in connection with non-instrumental observations, sufficient to show moderate monthly and annual ranges of temperature and the absence of extreme heat and extreme cold from the islands of the lake. However, the daily temperature range is considerable. Agassiz (quoted by Le Maire) gives 9.1° C., 6.6° C., 10.5° C., 5.5° C., as the difference in temperature between early morning and the hour of greatest heat during the months of January and February, 1875. Le Maire recorded 41.9° on July 25th at 5.30 A.M. at Challa and 33.8° at 6.45 A.M. at Puno on August 1st. The means of temperatures taken at Puno,[3] November, 1888, to March, 1889, inclusive, are: mean, 53.6°, maximum, 64.5°, minimum, 38.5°. The highest record was 71°, and the lowest 33°. The mean annual temperature of La Paz based on nearly ten years' records, as given by Merchant,[4] is 50.4°; the lowest temperatures occur in June and July, which give a mean of 45.3°, with an absolute minimum of 26.6° (June, 1901). The warmest months at La Paz are: November (53.9°) and March (54.7°). A maximum of 75.2° is recorded for January, 1903.

The sensible temperature is much less agreeable than the instrumental observations indicate, because the air, while cool, is also moist and chilly, and the increased insolation due to altitude makes midday temperatures of moderate amount appear uncomfortably hot. The variation of the temperature from hour to hour is a noticeable feature of the climate and doubtless accounts for the conflicting evidences afforded by instrumental observations. A temporary clouding of the sky produces a marked drop in temperature, while the sudden appearance of the sun is quickly recorded on the thermometer. While at work on Titicaca on several occasions a change of 5° to 10° was noted during a period of twenty minutes or less. At night it is uncomfortably chilly, in the afternoon uncomfortably warm; and putting on and taking off sweaters as clouds came and went was a feature of our daily work. Combined with the altitude the daily and hourly fluctuations of temperature seriously interfere with continuous, effective physical labor, even on the part of the natives.

Reliable precipitation records for Titicaca are wanting, yet the chief facts are sufficiently well known. The months of maximum precipitation are November to April, during which time thunderstorms may occur any day, and as many as one-half the days in a month may be marked by downpours. June to December is the dry season, during which time, however, rains or snows accompanied by thunderstorms occur at infrequent intervals. Rainfall records at Puno give a monthly mean for the rainy season (November to March, 1888–89) of 5.81 inches. Of 151 days on which observations were made, 67 were without rain. The total amount of precipitation on Titicaca Island probably does not exceed 35 inches,[5] and is distributed as short-lived showers rather than as downpours of long duration. As is to be expected in a region of varied topography and sudden short showers, there is wide variation in the amount and character of precipitation at neighboring localities.

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[3] *Annals Astron. Observ. Harvard Coll.*, Vol. XXXIX, Part 1, 1899.

[4] Estudio sobre la Climatologia de La Paz. La Paz, 1905.

Winter winds are prevailingly northwesterly, while those of the summer season come from the opposite quarter. The winds are, however, exceedingly variable in direction and violence. Sudden severe gusts, dangerous to navigation, are frequent accompaniments of summer storms, particularly through narrow straits as at Yampupata and Tiquina, where violent local winds are liable to be encountered. The influence on climate of the waters of Lake Titicaca, covering approximately 4,000 square miles,[6] must be considerable. So far as observations go the Titicaca shores have smaller annual, monthly and daily temperature ranges, more rainfall, and less rigorous and inhospitable climate than is encountered at other points on the *altiplano.*

The surface temperatures of the water of Lake Titicaca, as noted by Agassiz for the months of January and February, 1875, taken morning and afternoon, range from 53.9° to 59°, with only two of twenty-nine observations above 57.3°, and one below 54.68°, the mean of all observations being 55.8°. Le Maire's records for July, taken at various times during the day, give a mean for thirty-two observations of 52.55°. These two sets of observations may be taken to represent winter and summer conditions. The daily variations for the last six days of July were found by Le Maire to range between 1.6° C. and 0.3° C., a mean of 0.87° C. During the winter the temperature of the water is lower in the large division of the lake than in its smaller companion or in bays. During the summer the opposite conditions prevail. It is interesting to note that the waters of the lake maintain a mean temperature higher than that of the overlying atmosphere.

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[5] Bartholomew's Meteorological Atlas gives the mean annual rainfall of the Titicaca region as less than ten inches.

[6] No complete instrumental survey of Titicaca has been made. The figures used in this article are from Le Maire, whose traverses between July 13 and August 15, 1903, have resulted in the production of a map sufficiently accurate to replace those of Raimondi (1873), Marcoy (1877), Viscarra (1900), as well as the fantastic representations of several other writers. Markham's excellent map of South Peru and North Bolivia, *Geographical Journal,* 1910, includes data from Le Maire.

Fauna.—The indigenous fauna of Titicaca Island includes the llama and his relatives, the vicuña, guanaco and alpaca; the viscacha (a badger), guinea pig, field rat, lizard, toad. Birds are numerous and include the gray eagle, heron, a buzzard, besides song birds, and several species of water fowl. Bandelier mentions the presence of spiders, a scorpion, beetles, and a variety of hymenoptera. Hogs of uncommon aspect, which wade into the lake for food, cattle, which, like the ponies of the Hatteras beaches, have developed the habit of thrusting their heads deep into water to secure the succulent bases of reeds, chickens, dogs, cats, donkeys, probably date from the Spanish invasion. Agassiz describes two genera of fish from Lake Titicaca: *Trichomycterus* (a siluroid) with one species and *Orestias* with five species, and calls attention to the fact that the fauna of the lake in general is characterized by abundance of specimens and paucity and uniqueness of species. The isolated position of Titicaca, its elevation, its temperature, its silt-covered bed, and the limited variety of fish food, naturally tend to specialization of genera.

Flora.—The native flora of the island is wholly shrub and grass, with a sprinkling of annual and perennial flowering plants of inconspicuous size. In favorable localities on northern exposures are limited areas carpeted with green, as the bottom lands at Pucara and the grass-covered, rounded summits and divides of Ciriapata and Marcuni. And at the extreme northwest projection are thickets of gnarly, spine-protected shrubs. Elsewhere plant life is sparsely distributed, and over wide areas plants are to be found only in rock crevices, or along decaying artificial walls and *andenes*. A tall yucca (" kara " in the Aymara dialect; " comida de osa " of the Spaniards) predominates on steep slopes. Three indigenous trees have been described, species determined as *Polylepsis racemosa,* called by the natives "kenua," *Buddleya Coriacea,* à wild olive, and *Sambucus Peruvianus.* They are stunted and sharply localized. Perhaps the most attractive plant is the " Flor del Inca " (*Cantuta buxifolia*), a flowering shrub used as a model by the Inca decorators of pottery. Potatoes are native to the whole Andean plateau, and several species or varieties are indigenous to the islands and shores of Titicaca, only a few of which have been domesticated. A cabbage occasionally attaining the dimensions of a shrub is a feature of the landscape. The " totora," a reed ten to twenty feet in height, grows profusely and forms a belt a few feet to a mile or more wide, where shallows permit a foothold, and serves as a guide to the depth of the water. At the entrance to the bay of Puno and again at

Guaqui the growth is so rank that artificial canals are required for the passage of steamers (Fig. 3).

With the advent of the Spaniards trees and garden plants and flowers found a place, and such as would thrive in this inhospitable climate are represented on the island, confined, however, to localities where soil and water and sun and care of man combine to produce favorable conditions. Thus in the " Garden of the Incas " at Challa and again at Yumani are found eucalyptus and willows, violets, heliotrope, geraniums, roses, dahlias, pinks, and other European plants, as well as vegetables and fruits of temperate zones. As remarked by Bandelier, the attractive floral features of Inca settlements on Titicaca date from colonial times. The same might be said of Cuzco and other centers of Inca population. Divested of all which the Spaniards supplied, these " gardens " would still be attractive to one who sees beauty in landscapes slightly modified by human activity, but would scarcely appeal to the casual traveler.

The native elements of food, used by the original inhabitants and present population alike, consist of fish, especially the boga (*Oretias Pentlandii*), the llama and related species, the viscacha, ducks, birds' eggs, the tender parts of the totora, oca, quinoa, but chiefly the potato. This supply doubtless was supplemented somewhat by hunting expeditions on the mainland and by the transport of tropical fruits from the lands beyond the eastern Cordillera. The food of the present inhabitants includes the indigenous meats and vegetables supplemented by the addition of mutton, beef, corn and barley.

Fuel.—The native fuel consists of roots and branches of shrubs exceedingly limited in amount, and of " taquia " (llama dung). The latter has played an important rôle in the life of the aboriginal and present inhabitants alike. Since there are no trees within a hundred miles of the lake, the *taquia* was the only available material and took the place of wood and coal, not only for household purposes, but also for copper smelting and later to supply the furnaces of steamers navigating the lake.[7] Camping on the Titicaca plateau and islands involves carrying an oil stove, and the luxury of a camp fire is not to be had. Fortunately the llamas have the admirable habit of depositing their excrement in selected places to which they repeatedly return and thereby accumulate large quantities of this indispensable material.

As outlined above the physical environment of the natives of Titicaca forms an uninviting prospect. Scenery most magnificent, marked by grandeur, variety and beauty of color, is combined with an unpropitious climate, scarcity of food and fuel, and, from the standpoint of physical comfort and industrial progress, the island may indeed be called monotonous and forbidding. The lot of the aborigine on the Titicaca plateau has been concisely described by Bandelier.[8]

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[7] Orton reports that the steamer in which he crossed the lake in 1876 used dung for fuel.

> Nature is most cheerless in that region. Dismal monotony reigns all around, in topography, and in color of landscape; a stunted vegetation, animal life distributed by local groups and with few prominent forms. The climate is as monotonous as the landscape, in the slight variations of temperature which it exhibits throughout the year; cold, moist, and abounding in threatening phenomena, dangerous to man directly and indirectly. There are no means for rendering comfortable the shelter which one builds, for the Puna has scarcely any combustible material within reach of the native except llama dung: "taquia." The only redeeming features are: The sight of the glorious Andes, and the magnificent sky, when it condescends to exhibit itself in full splendor. These redeeming features, however, have no influence on the Indian; *his* heart is untouched by beauties of nature.

Furthermore there is at present no undisputed evidence that nature was in any marked degree more hospitable at any time during the human epoch. In the days when the Island of the Sun was the center of a powerful religious cult whose devotees brought treasure and building materials and even soil from regions far removed, the contest with nature must have enlisted the physical and mental energies of the group. Why then should a region so unfavorable from the standpoint of civilized man be marked by long and continuous occupation? The explanation, I believe, lies in the facts that the island is a natural refuge, not easily reached, that fish, water fowl and potatoes furnished a reliable source of food, and that the plateau as a whole is still less adapted to man's needs. It is probable also that more suitable localities on the great plateau had previously been occupied and perhaps overpopulated.

ADJUSTMENT TO ENVIRONMENT.

To the physical factors of his environment, the Titicaca Indian slowly became adjusted and, spurred on by the imperative demand for sustenance, followed the suggestions of nature, and in a crude way, at unbelievable physical exertion, developed agriculture and the arts of caring for stock and catching fish. Agriculture is now the chief occupation of the seven hundred Indians inhabiting the island, and probably differs in no essential of kind of crop or method of culture from that practiced during the Inca Empire. Potatoes of several varieties, quinoa, beans, a little corn, and some barley are the principal crops. Small, knobby potatoes in the natural state or as " chuña " (potatoes frozen, then dried) are the mainstay and, for the poorer families, may constitute, with mutton, nearly the whole bill of fare. By selection of seed and variation in time of planting, the potato harvest is extended over several months. Coca, transported from the Yungas Valley, is the solace of Aymara and Quichua alike, is universally used, and reaches the dignity of a food in the Indian dietary. Cultivation is almost wholly hand work performed with implements so crude in design and construction that even when oxen are used the saving in labor is inconsiderable. Sheep dung is used as a fertilizer.

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[8] The Islands of Titicaca and Koati, p. 20.

In a region where rainfall is seasonal and fluctuating in time and amount and where soil is deficient in nitrogen, irrigation and drainage and terracing and systems of crop rotation naturally become features of agricultural practice; and the Aymaras, even before the Inca invasion, apparently were aware of the advantages to be derived from the development of these arts. On Titicaca Island irrigation by gravity ditches of crude workmanship is in evidence. The system of conduits feeding the " Fountain of the Incas " at Yumani, described as an irrigation plant, is in reality a device for drainage of an overwatered flat, for, as first pointed out by Bandelier, the buried troughs are below the level of the fields which they are supposed to have irrigated. At the " Garden of the Incas," near Challa, a system was devised for the combined purposes of drainage and irrigation of a very small tract of productive land.

Frequent crop failures have led the Indians to supplement their efforts in controlling the water-supply by calling in supernatural agencies. Each spring and water course has its familiar spirit. A part of the " Chayll'pa " dance consists of throwing stones or toads into the lake, as a means of calling the attention of the divinities to the perilous state of the crops. My guide spoke of the native belief that to disturb the bones of ancestors is to ensure drought—a notion which may account for the strenuous objection in some districts to the desecration of sepulchres under the guise of archæological research. Similarly, excess of rain is prevented by exposing a skull taken from a burial place at some conspicuous point, occasionally placing a cigarette between its teeth—a performance which

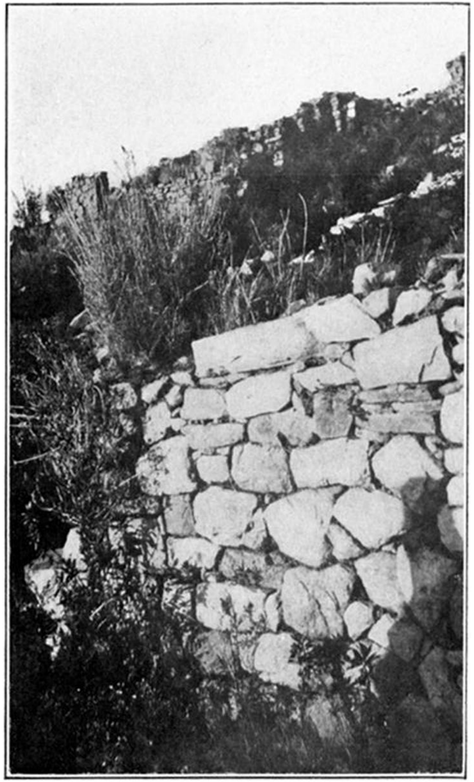

Fig. 5—Incaic wall forming the front of an *andene.*

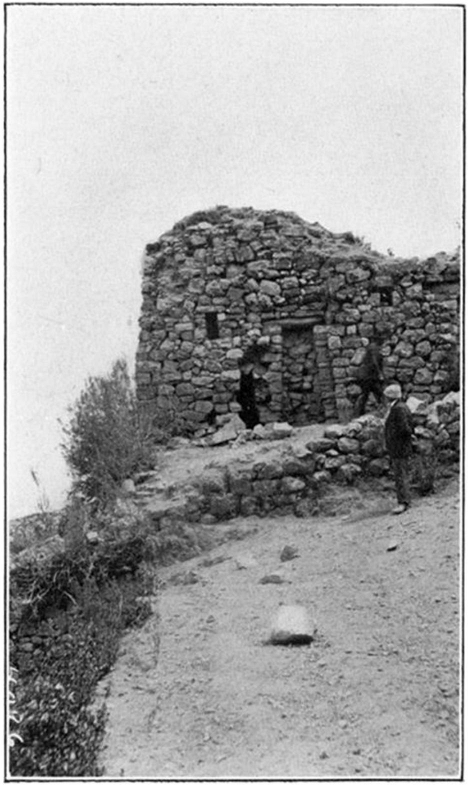

Fig. 6—Incaic "temple" wall at Yumani.

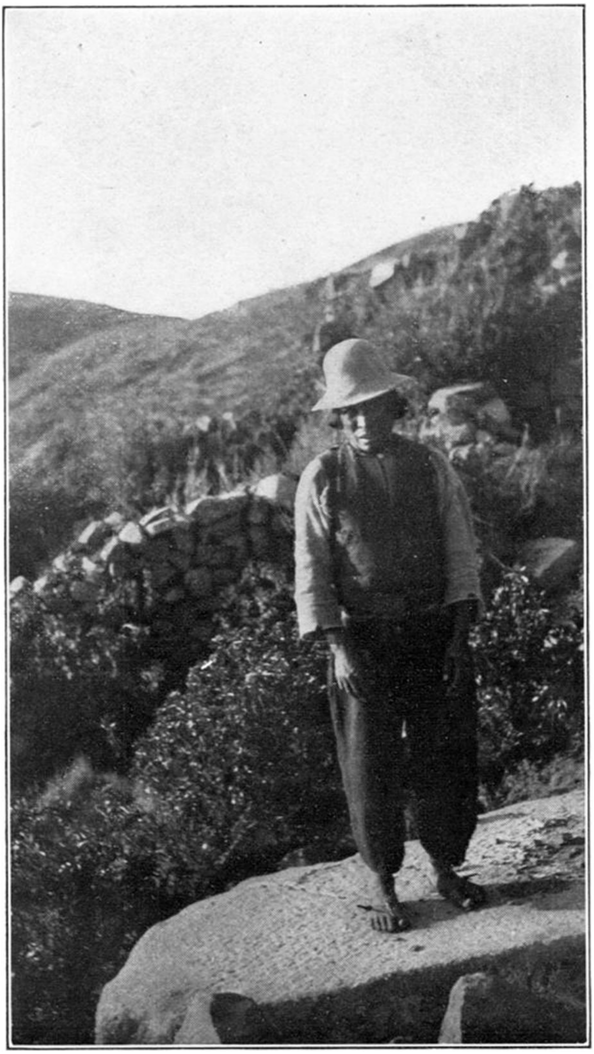

Fig. 7—Aymara Indian, Titicaca Island.

I am informed is entered into most seriously and with confidence in the results. Faith in the guardian spirits of cloud and storm is shown by the well-known fact that the Indians of Tiahuanaco invoke the rain gods by sacrificing coca, and so mysterious and powerful are meteorological phenomena believed to be that children are forbidden to gaze at a rainbow. Analogous ceremonies are practiced by the Quichuas of Peru, which invite a suggestive comparison with the Snake Dance of the Hopis and the processions and dances of other Pueblo tribes.

Terracing of hillsides to retain the soil is essential to profitable agriculture where steep slopes, scantily clothed with vegetation, predominate, and the farmers of Titicaca Island have built an elaborate system of *andenes* designed to preserve the small amount of arable soil available (Fig. 4). These terraces, with fronts rising two to fifteen feet, and each one reclaiming a fraction of an acre of land, follow the contour of the hills and rise as a series of steps four or five to twenty in number. They are confined almost entirely to north and northwest slopes where exposure to the sun provides the necessary warmth. In cruising among the islands and particularly at the straits of Tiquina and in the Lago Pequeno, the stranger might determine his directions by noting the position of *andenes,* cultivated and abandoned, which striate the slopes. Pre-Inca, Inca, and post-Inca *andenes,* distinguished by their types of workmanship, are represented (Figs. 5 and 6).

Rotation of crops, or "fallowing," is required in order to insure the accumulation of nitrogen, phosphorus, and other essential plant foods. Abandoned fields do not therefore always indicate decreased agricultural activity or diminished population. A four-year period of rotation would in general require about four times the present acreage of tilled land to support the existing population. In view of this fact and of the agricultural possibilities of Titicaca, it is doubtful if at any time the population of the island supported by local food supply exceeded in any appreciable amount the 700 or 800 Indians now occupying it.

Access to the mainland and intercourse between the island communities is made possible by the curious *balsas,* canoe-shaped boats frequently united in pairs with hulk and sail alike ingeniously constructed of native reeds (*totora*) (Fig. 2). The *totora,* gathered along the south shore of the island, are tied in bundles, which in turn are lashed together by vegetable fibers. To the stranger the *balsa* is an uncomfortable and unsafe craft, but, driven by necessity, the Indian has developed such skill and daring that, not fearlessly, but in spite of fear, he navigates the lake from end to end, more or less regardless of sudden violent squalls. His skill in righting his overturned craft in rough, chilly water excites admiration. Posnansky states that a yoke of oxen has been carried in a single large *balsa,* and believes that the gigantic monoliths of ancient ruins bordering the lake were transported in these frail craft.

Animal husbandry in pre-Colonial days consisted in the care of llamas, limited in number by deficiency of grazing lands, as are also the small flocks of sheep and smaller number of low-bred cattle, which require the attention of the present inhabitants.

The Aymara Indians, who, with the addition of a dozen Spaniards, constitute the population of Titicaca Island, are stockily built and somewhat below medium height (Fig. 7). The Aymara is a good workman in a perfunctory way, and while not mentally alert or possessed of initiative is by no means stupid; while his mental processes apparently lack directness and simplicity, he can hardly be called crafty in spite of his skill in bartering and in accomplishing good or evil by roundabout methods. Like other South American plateau Indians, the Titicacan's dress consists of woolen shirt and short trousers, supplemented by a hat or by a cap with ear-laps. His feet are bare, and it is a constant source of wonder to see these people warmly clad about head and shoulders, wading in the cold lake waters, tramping over chilly, moist rocks and even wading through snow with no protective clothing below the knee. The costume of the women differs little from that of the men, except for the addition of innumerable short skirts. Laundering is a little practiced art. Little wonder that coughs and pneumonia are persistent tribal diseases.

Houses are assembled in groups rather than in villages; land is held in common and redistributed at stated intervals. There is a division into clans governed by elective officers, and marriage is allowed both within and without the clan group. The stage of development of arts and industry, as well as religious, social and burial customs, remind me forcibly of conditions observed among the Pueblo tribes of New Mexico and Arizona, and, as with the North American races, the Aymara arts appear to have reached culmination at some remote date and to have later declined. In my view, the Titicaca Indian of to-day differs little from his ancestors who first occupied the Island of the Sun. The one hundred years' domination of the Incas has left few traces except buildings and perhaps a slight modification of agricultural practices. With the coming of the Spaniard in 1533, new types of domestic animals and plants were introduced, which increased the food supply, but were otherwise of little value to the island population.

To his mental outfit the forced acceptance of Christianity added new conceptions, the net result of which appears to be an elaboration of an already intricate hodgepodge of mysticism and nature worship by the addition of a maze of indigestible ideas. With the new régime came also forced contributions levied on a people already pitiably poor; as if the exactions of nature were not a sufficient handicap. To my mind, "discouraged," "despondent," "indifferent," attitudes of mind resulting from centuries of struggle with nature—a struggle whose issue is always in doubt—more nearly describe the Titicaca Indian, than "indolent," "surly," "wicked"—terms frequently used in speech and in print.

Titicaca Island may be visited by arranging for transportation at Puno, the Peruvian terminus of the Ferro carril del Sur. The journey will well repay the time and effort expended.

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